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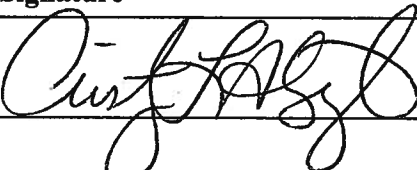
## Assembly Procedure for LANL Special Form Capsules

Effective Date: 7/19/11

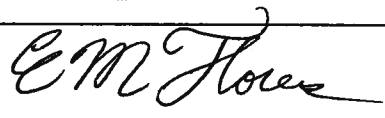
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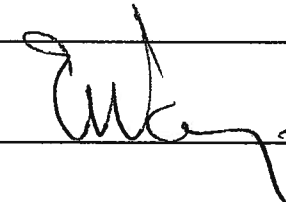
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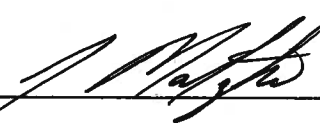
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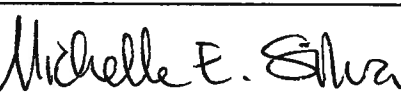
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## HISTORY OF REVISIONS

Revision	Issue Date	Action	Description
R.0		New Document	This document creates requirements for field assembly of LANL Special Form Capsules within the scope of the Off-Site Source Recovery Project. It results from the joining of OSR-OP-170 & OSR-OP-180, and incorporates recommendations resulting from the special form certification process at DOT.
R.1		Revision	Add weight limits on capsules. Revise traveler sheet.
R.2		Revision	Add drawing numbers to capsules. Revise traveler sheet.

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## **1.0 PURPOSE**

This procedure provides instructions for assembly of all Los Alamos National Laboratory (LANL) Special Form Capsules (SFCs).

Quality assurance (QA) measurements and initial packaging are performed in accordance with Section 6.0. The tasks required in Section 6.0 will be completed prior to the dispatch of an SFC to the field. Placement of sources in special form, assembly, and closure of the SFC will be completed as described in Section 7.0.

## **2.0 SCOPE**

This procedure applies to the use of SFCs for containment of sealed sources. This procedure is used for closing the SFC models I (LANL Drawing 90Y-219966 (latest revision)), II (LANL Drawing 90Y-219998 (latest revision)) and III (LANL Drawing 90Y-220045 (latest revision)).

## **3.0 DEFINITIONS AND ACRONYMS**

### **3.1 Definitions**

Sealed Source	Radioactive material that is contained in a sealed capsule, sealed between layers of non-radioactive material, or firmly fixed to a non-radioactive surface by electroplating or other means. The confining barrier prevents dispersion of the radioactive material under normal and most accidental conditions related to the use of the source ( <i>from Implementing Guide for Occupational Radiation Protection (GN5400.9/M1) Sealed Radioactive Source Accountability and Control</i> ).
Special Form	Department of Transportation Class 7 Radioactive material which satisfies the following conditions: 1) it is either a single solid piece or is contained in a sealed capsule that can be opened only by destroying the capsule, 2) the piece or capsule has at least one dimension not less than 5 millimeters (0.2 inches); and 3) it satisfies the test requirements of Code of Federal Regulations (49 CFR 173.469).

### **3.2 Acronyms**

ALARA	As Low As Reasonably Achievable
CVT	Clearance Verification Tool
IWD	Integrated Work Document
OSR	Off-Site Source Recovery
PSDT	Plug Seating Depth Tool
QA	Quality Assurance
SFC	Special Form Capsule

## **4.0 PRECAUTIONS AND EQUIPMENT**

### **4.1 Precautions**

Users of these capsules must follow their internal safety precautions and/or the safety precautions required by responsible parties at the encapsulation location.

Sufficient void volume must be provided in the closed SFC to avoid any potential pressure buildup to unsafe levels. The table below indicates the minimum capsule volume in cubic inches (in<sup>3</sup>) (along with minimum void volume %) that must remain void or empty following the loading of sources. This minimum void volume can be assured by measuring the distance in inches from the top of the loaded sources to the bottom of sealing plug. The minimum depth in inches is also provided in the table for the various models.

SFC Model #	Capsule Volume (in. <sup>3</sup> )	Internal Diameter (in.)	Internal Depth (in.)	Minimum Void Volume (will always exceed) (in. <sup>3</sup> ) or (in. depth) or (%)	Weight Limit (g)
Model I, Type 2	3.53	1.0	4.5	0.30 or 0.3 or 8.5%	300
Model I, Type 4	0.39	1.0	0.5	0.30 or 0.3 or 77%	80
Model I, Type 5	1.18	1.0	1.5	0.30 or 0.3 or 25.5%	235
Model I, Type 6	1.96	1.0	2.5	0.30 or 0.3 or 16%	390
Model III	7.95	1.5	4.5	0.67 or 0.4 or 8.5%	1000
Model III (long)	15.02	1.5	8.5	0.67 or 0.4 or 4.5%	1700
Model II	28.38	2.0	8.5	0.67 or 0.2 or 3%	2500

Users are also responsible for ensuring only permitted metals and alloys which are limited to aluminum, beryllium, copper, copper alloys, brass, brass alloys, bronze, bronze alloys, gold, silver, stainless steels, high nickel and chrome alloys, titanium, vanadium, tungsten, and ceramics (e.g. ceramic fiber packing material) are encapsulated.

All capsules must exclude any plastic, hydrocarbon, or hydrogenous materials as part of the capsule contents.

**NOTE:** The Clearance Verification Tool (CVT) for the Model I and III only, has been designed to ensure that the space above the source(s) is sufficient to accommodate the tapered sealing plug and to ensure that the required minimum void volume is exceeded. This is verified if the CVT lies flat on the surface of the SFC as specified in this procedure. Pressure should not be applied to the CVT.

The Model II capsule is designed and used such that an impact limiting disk and snap ring exist inside the capsule body to separate the contents from the sealing plug. Due to this design feature, a certain/fixed amount of void space is guaranteed between the bottom of the sealing plug and the top of the snap ring which none of the contents can encroach.

Therefore, it is unnecessary to estimate the void volume while performing Model I, II or III capsule loading/closing in accordance with this procedure.

## 4.2 Materials and Equipment

- Two 6" C-clamps
- SFC base plate (with Model I & III inserts/adaptors)
- SFC wrench
- SFC polyethylene ("poly") neutron shielding during assembly (for neutron-emitting sources)
- PSDT (Plug Seating Depth Tool)
- CVT (Clearance Verification Tool for Model I & III)
- Calibrated Depth gauge (such as a dial micrometer)

- Special Form Capsule Package (containing container body, threaded cap, sealing plug, and Special Form Capsule Traveler Sheet, Form OSR-036 – Attachment 1)
- Anti-seize lubricant (Krytox)
- Clean gloves (cotton or nitrile)
- Etching tool w/ bit
- Snap ring tool

**NOTE:** *Verify the existence of and become familiar with each component prior to proceeding.*

## **5.0 RESPONSIBILITIES**

Users of this procedure are responsible for ensuring that the SFCs are assembled in accordance with this procedure.

If measurements are not within the indicated tolerance, capsule must be rejected and documented on the SFC Traveler Sheet. Capsule must be etched with the word REJECTED to prevent future use.

## **6.0 QUALITY ASSURANCE AND PACKAGING**

This section specifies the tasks involved in assembling and packaging of the SFCs prior to field use to assure quality; and to guarantee a seal. For documentation purposes, a SFC Traveler Sheet (Form OSR-036 – Attachment 1) will be used to record all findings and measurements. This document, when completed, becomes the record for assuring closure in accordance with design requirements. Therefore, legible writing is mandatory.

- Degrease all parts of the SFC with ethanol to remove any oils or cutting fluids. Ensure ethanol is completely wiped off.
- Put on a clean pair of gloves.
- Inspect the tapered sealing plug and mating surface of the container body for scratches, gouges, and nicks. If defects are noted on either part, reject the item, document the rejection on the SFC Traveler Sheet and etch the item as rejected to prevent further use. If no defects are noted, record the findings on the SFC Traveler Sheet, initial and date.
- When using a calibrated depth gauge, zero the instrument by placing it on the PSDT, on the SFC body without cap in place and turning the dial to zero.
- Record dial gauge serial number and calibration date.
- Remove the gauge and PSDT and hand-tighten the threaded cap onto the container body.
- Place the PSDT on the top of the threaded cap and use the depth gauge to measure the gap measurement without the sealing plug in place. (Apply light/even pressure on top of PSDT with one hand while making the measurement.)
- Record the results on Line 1 of the SFC Traveler Sheet.
- Remove the PSDT and threaded cap.
- Gently insert the sealing plug into the container body. Do not apply pressure to the plug.

- k. Hand-tighten the threaded cap onto the container body.
- l. Place the PSDT on top of the threaded cap and use the depth gauge to measure the gap measurement with the sealing plug in place. (Apply pressure on top of PSDT with one hand while making measurement.)
- m. Record the results on Line 2 of the SFC Traveler Sheet.

*Note: These two measurements are the baseline measurements that will be used in the field to check that the SFC has been packaged properly and has not been damaged in transit.*

- n. Sign and date SFC Traveler sheet in top QA section.
- o. Remove the PSDT, threaded cap and sealing plug.
- p. Wrap the sealing plug securely in bubble wrap. This prevents any marking or scratching during shipment.
- q. For packaging purposes, hand-tighten the threaded cap onto the container body.
- r. Package the SFC, including all required components, and the SFC Traveler Sheet into appropriate containers and seal in a plastic bag to prevent loss or separation of components.

## **7.0 ASSEMBLY PROCEDURE**

This section specifies the tasks involved in field assembly of the SFC, along with applicable requirements and performance criteria. All parts of the capsule must have been degreased with ethanol, verified using the QA procedure above, and enclosed in a sealed package.

### **7.1 Verification of Special Form Capsule Traveler Sheet (Attachment 1)**

Each package includes a SFC Traveler Sheet (Form OSR-036, see Attachment 1). This document has been prepared to assure QA compatibility between the SFC body and the sealing plug. There is data already entered on the traveler sheet. This data was obtained during the QA inspection (Section 6.0 above) when the SFC packages were being initially assembled.

- a. Open the package and retrieve the SFC Traveler Sheet

*NOTE: Compare the version of the SFC Traveler Sheet in the package with the current version attached to this procedure. If an older version is found, use the most current revision of the traveler, and attach the completed document to the older original traveler found in the package.*

- b. Verify that the following information has been entered on the SFC traveler sheet (copy from old version if necessary):
  - SFC identification number.
  - Visual inspection results.
  - QA signature
  - Date
  - QA gap measurement without plug in place (line 1).

**NOTE:** This entry is used to determine the minimum value of the gap measurement required to assure that adequate seal is achieved.

- QA gap measurement with plug in place (line 2).

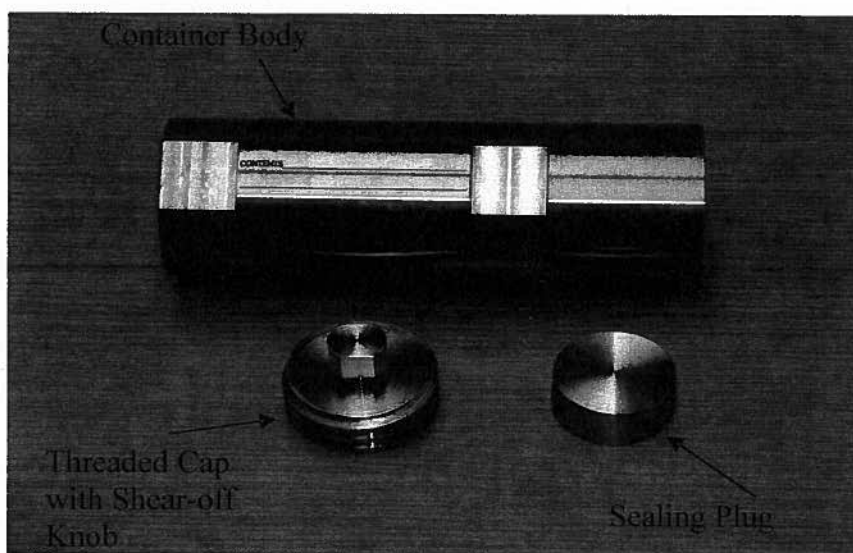
**NOTE:** This entry is the gap measured with the plug loosely in place to assure that the plug is adequately over-sized to permit a quality seal to be achieved.

- c. Verify that the special form capsule identification number on the SFC Traveler Sheet matches the SFC serial number stamped on the container body.

**NOTE:** Lines 5 and 6, "gap measurement after sheer off of nut" and "the difference between line 5 and line 4" are to be completed following the sealing of the SFC. When filling out the SFC Traveler Sheet, **write legibly**. When completed, this document is a record of the special form nature of the capsule.

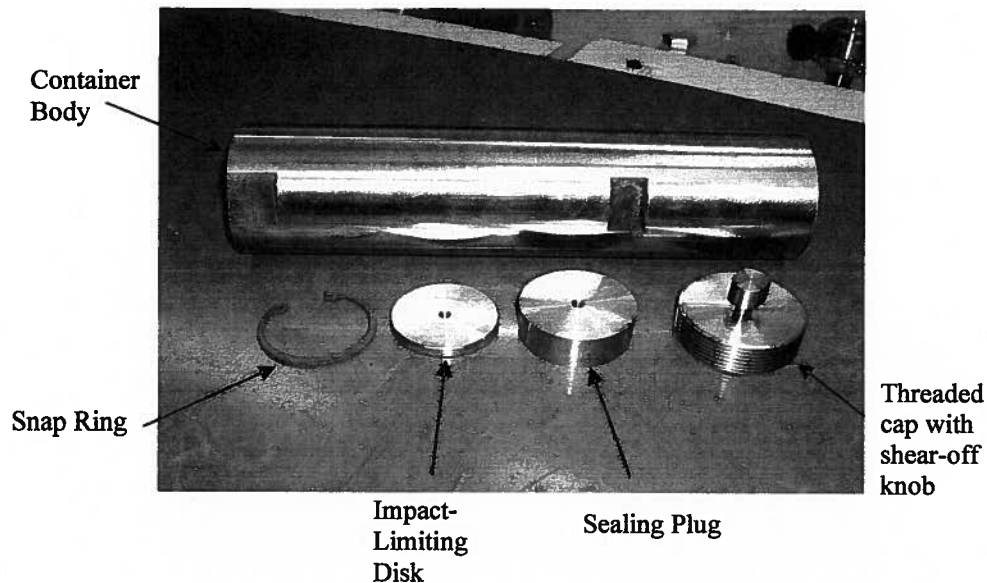
## 7.2 Capsule Inspection

- a. Put on a clean pair of gloves.
- b. Verify the following items are available in the package (Figures 1 and 2):
  - Sealing plug
  - Threaded cap with shear-off knob
  - Container body
  - Snap ring (Model II only)
  - Impact-limiting disk (Model II only)



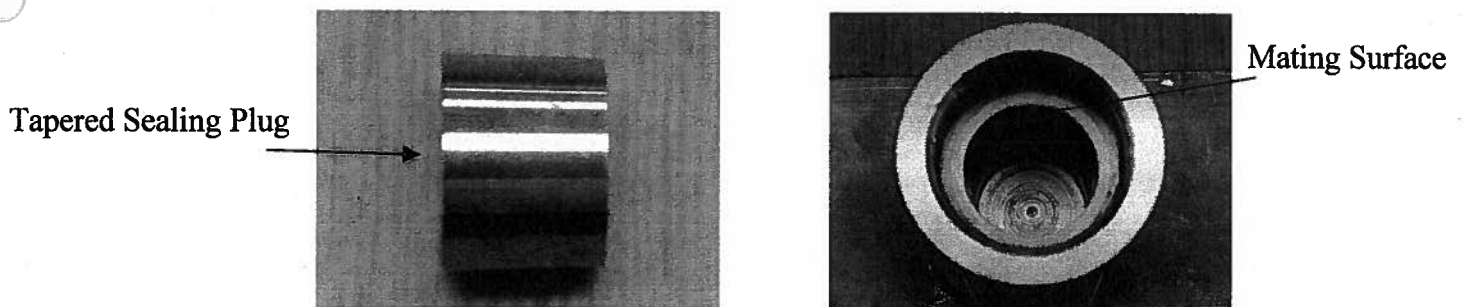
**Figure 1: Model I and III Special Form Capsule Components**





**Figure 2: Model II Special Form Capsule Components**

- c. Inspect the tapered sealing plug and mating surface for scratches, gouges, debris, and nicks. (Figure 3)



**Figure 3: Tapered Sealing Plug and Mating Surface**

- d. If defects are noted on either part, reject the capsule, document the rejection on the SFC Traveler Sheet, and etch the capsule as rejected to prevent further use. If no defects are noted, mark okay/OK on the field inspection results line near the top, then initial and date the SFC Traveler Sheet under field inspection results.
- e. Inspect the threads on the threaded cap and the container body. Assure a proper fit by screwing the threaded cap hand-tight onto the container body.
- f. If defects are noted on the threads and there is not a proper fit, reject the capsule, and document the rejection on the SFC Traveler Sheet.
- g. Verify the QA gap measurements on SFC Traveler Sheet.

- Ensure dial gauge is calibrated; zero the instrument by placing it on the PSDT on the SFC body without cap and turning the dial to zero.
- Record dial gauge serial number and calibration date on the SFC Traveler Sheet.
- Remove gauge and PSDT and hand-tighten the threaded cap onto the container body.
- Place the PSDT on top of the threaded cap and use a calibrated depth gauge to measure the gap measurement without the sealing plug in place. (Apply light/even pressure on top of PSDT with one hand while making the measurement.)
- Record field results on Line 3 of the SFC Traveler Sheet.  
(This measurement must be within  $\pm 0.005''$  of QA measurement for any Model I)  
(This measurement must be within  $\pm 0.010''$  of QA measurement for any Model II or Model III)

*NOTE: If measurements are not within the indicated tolerance, reject the capsule and document the rejection on the SFC Traveler Sheet. Mark the capsule to prevent future use.*

- Remove the PSDT and threaded cap.
- Gently insert the sealing plug into the container body. Do not apply pressure to the plug.
- Hand-tighten the threaded cap onto the container body.
- Place the PSDT on the top of the threaded cap and use the depth gauge to measure the gap measurement with the sealing plug in place. (Apply pressure on top of PSDT with one hand while making the measurement.)
- Record the field results on Line 4 of the SFC Traveler Sheet.  
(This measurement must be within  $\pm 0.005''$  of QA measurement for any Model I)  
(This measurement must be within  $\pm 0.010''$  of QA measurement for any Model II or Model III)

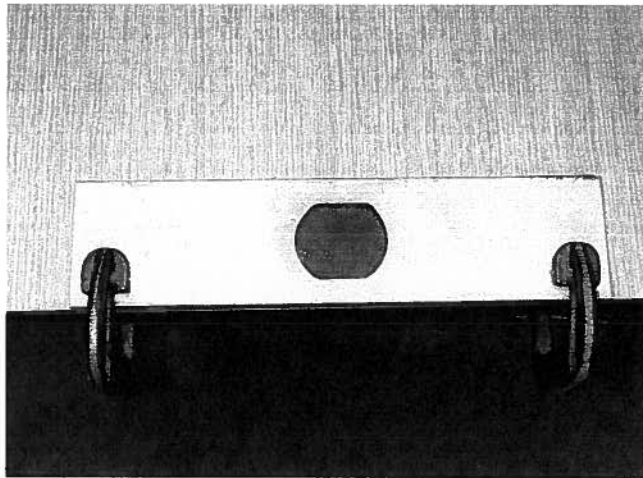
*NOTE: If measurements are not within the indicated tolerance, reject the capsule, and document the rejection on the SFC Traveler Sheet. Mark the capsule to prevent future use.*

- Remove the PSDT, threaded cap and sealing plug.

### 7.3 Assembly

**CAUTION:** To maintain radiation dose As Low As Reasonable Achievable (ALARA) it is recommended that steps a. through e. below be completed before any source is moved to the capsule loading area.



- a. Using C-clamps, secure the appropriate SFC holder to a suitable surface. An example is shown in Figure 4. Other methods may be used to secure the holder.



**Figure 4: SFC Holder attached to table.**

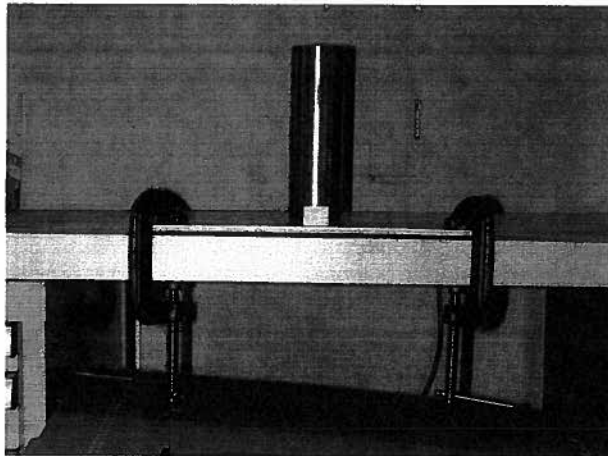
**NOTE:** It may not be possible to determine in advance how many sources will fit in one SFC. If the final activity of the capsule is not known prior to loading, the Field Team Leader will ensure that all information except activity is scribed prior to capsule loading and that ALARA practices are used when scribing the activity on the loaded/sealed capsule.

- b. Record the physical/chemical form, isotope, activity, and the serial number of all verified sources on the SFC Traveler Sheet. If numerous sources are loaded in the capsule, itemize all sources and activities and attach a separate sheet. **Write legibly, the traveler sheet is a record.**
- c. Record isotope and activity on the contents area of the SFC with an etching tool. See Figure 5. If capsule contains no more than 2 sources, etch each source serial/ID number(s). If three or more sources are contained in the capsule, etch the isotope and the total activity.

	<b>DANGER – RADIOACTIVE MATERIALS IF FOUND, NOTIFY CIVIL AUTHORITIES</b>	
LANL US DOT SPECIAL FORM CAPSULE SN# _____		
CONTENTS _____		
_____		

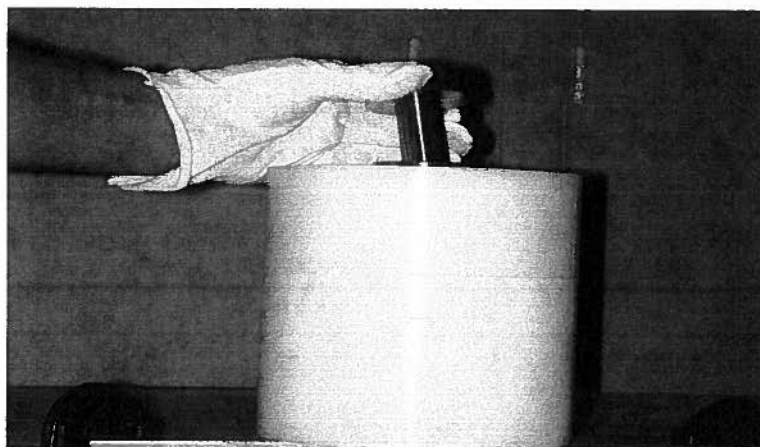
**Figure 5: Sample of the space provided on the SFC body for etching.**

- d. Apply a 1-2 mm small bead of anti-seize lubricant to the inlet threads of the cap and set aside.
- e. Place the SFC container body in the cavity of the SFC holder. See Figure 6.



**Figure 6: SFC in the holder.**

- f. Use polyethylene shielding for neutron sources as required in order to maintain dose rates ALARA. Other shielding options, such as lead-brick should be considered for gamma sources. (The shielding provided can be assembled to accommodate different SFC heights).
- g. Transfer the verified source(s) to the SFC assembly area and place the source(s) into the SFC container body.
- h. Check for proper clearance and verify void volume using the CVT (Model I & III only, as described in Section 4.1). See Figure 7. (If minimum clearance is not achieved, suspend work, place source(s) in a safe configuration, and re-evaluate source loading.) Do not force the CVT into place.



**Figure 7: Using the CVT on a shielded Model III SFC.**

**Model II only (for any Model I or III, skip to step l.)**

- i. Insert the impact-limiting disk above the source(s)
- j. Insert the snap ring - use caution to assure the mating surface is not scratched or nicked.

**NOTE:** It is suggested that the SFC users practice placement of the snap ring prior to source loading in a low radiation field. Practice will improve placement efficiency and therefore worker dose rates will be minimized.

- k. Check for proper clearance. If the snap ring will not seat into the snap ring groove, the minimum clearance has not been achieved. Suspend work, place source(s) in a safe configuration and re-evaluate source loading. If okay, proceed to next step.

**All Models (perform the following steps in an efficient manner to minimize dose)**

- l. Insert tapered sealing plug (narrower end first) into the container body.
- m. Hand-tighten the threaded cap onto the container body.
- n. Wipe off excess anti-seize lubricant, if necessary.
- o. Place the PSDT on top of the cap and use the depth gauge to validate the gap measurement with the sealing plug in place, previously recorded on line 4 of the SFC Traveler Sheet. See Figure 8. (Apply pressure on top of PSDT with one hand while making the measurement).

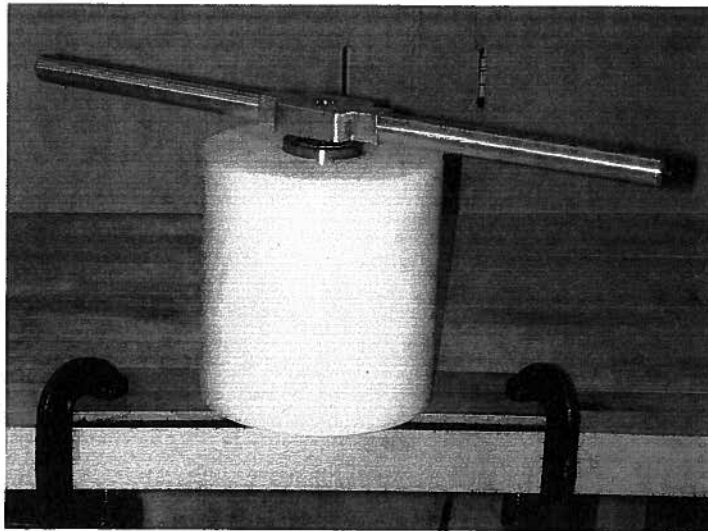


**Figure 8: Using the PSDT and dial micrometer.**

**NOTE:** If this reading is different from the entry on Line 4 of the SFC Traveler Sheet by less than  $\pm 0.005''$  for any Model I; or  $\pm 0.010''$  for any Model II or Model III, the SFC is ready to be sealed. If the reading is not within this tolerance, remove the threaded cap and sealing plug, and inspect for debris. Replace the sealing plug and threaded cap and then re-measure. If the problem is not corrected, suspend work, place source(s) in a safe configuration and re-evaluate source loading.

- p. If the tolerance is met, remove the PSDT and proceed.
- q. While the SFC is in the SFC holder, tighten the nut with the SFC wrench until the stem shears off. See Figure 9.

**NOTE:** The nut stem is designed to shear off when sufficient torque has been added to drive the plug into the tapered hole and achieve the proper seal.



**Figure 9: SFC wrench attached to the shielded SFC.**

- r. Wipe off excess anti-seize lubricant from the top of the SFC, if any.
- s. With the nut sheared off and the SFC sealed, place the PSDT on top of the SFC and again measure the gap with the depth gauge, as in Figure 8. Record this value on line 5 of the SFC Traveler Sheet
- t. Determine and record the value on Line 6 of the SFC Traveler Sheet by subtracting line 5 from line 4.

## **8.0 SEAL VERIFICATION**

The special form seal is only acceptable if it meets the following criteria:

- a. The gap measured on Line 5 of SFC Traveler Sheet is greater than or equal to the measurement on Line 3.

**AND**

- b. The value on Line 6 is a positive number and greater than or equal to 0.005 inches.

## **8.1 Seal Assembly**

- a. Indicate special form qualification by checking the appropriate block near the bottom of the SFC Traveler Sheet.
- b. If the seal meets the criteria in Section 8.0, both the SFC packager and a verifier must sign and date the SFC Traveler Sheet and keep a copy for their records.
- c. If the seal does not meet the criteria, put the work in a safe condition. Do not continue with capsule packaging. If the seal criterion is not met, the capsule cannot be considered "special form" for transportation purposes.
- d. Remove the SFC/Source assembly to an appropriate storage or transportation container following appropriate radiation handling procedures.

## **9.0 TRAINING**

Workers implementing this procedure shall be trained in accordance with this document and any other training deemed necessary by their employer for safe usage of the capsules described herein. DOT, NRC, and/or the user's State Authority training requirements must also be met.

## **10.0 REFERENCES**

49 CRF 173.469	<i>Tests for Special Form Class 7 (Radioactive) Materials</i>
OSR-OP-300	<i>Personnel Training</i>
OSR-OP-130	<i>Work Plans For Source Recovery Operations at Off-Site Locations</i>
AET-IWD-TE-01	<i>ESA-AET Integrated Work Document (IWD)</i>
IWD-0005273	<i>Source Recovery Integrated Work Document (IWD)</i>

## **11.0 ATTACHMENT: Special Form Capsule Traveler Sheet (Form OSR-036, Rev 7)**

## Special Form Capsule Traveler Sheet

Special Form Capsule Identification number: \_\_\_\_\_

QA Visual results: \_\_\_\_\_ Field Inspection results: \_\_\_\_\_ Initials: \_\_\_\_\_

QA Signature: \_\_\_\_\_ Date: \_\_\_\_\_

	QA	Field
QA Capsule gap measurement without plug in place:	1. _____	3. _____
QA Capsule gap measurement with plug in place:	2. _____	4. _____
Record gap measurement after shear off of nut:		5. _____
Subtract line 5 from line 4:		6. _____

**To achieve a Special Form seal, the measured reading on Line 5 must be greater than or equal to the measurement on Line 3 and the difference on line 6 must be a positive number and  $\geq 0.005$ ".**

Serial or ID number of source(s) loaded in SFC: \_\_\_\_\_  
(Attach separate listing if necessary)

Physical/Chemical Form: \_\_\_\_\_ Isotope(s): \_\_\_\_\_

Refer to the following certificates for activity and mass limits:  
USA/0696/S-96 Model II, USA/0695/S-96 Model III

Total Activity: \_\_\_\_\_ Total Mass: \_\_\_\_\_

Location of loading: \_\_\_\_\_

Dial gauge S/N: \_\_\_\_\_ Calibration Due Date: \_\_\_\_\_

### Special Form Qualification – All Criteria listed below must qualify as "YES" to Achieve Special Form Classification

	YES	NO
Capsule was assembled in compliance with the U.S. DOT Special Form Certification effective at the time of assembly and in accordance with OSR-OP-190.		
The capsule seal complies with the requirements of OSR-OP-190 Section 8.0		
Void volume verified by CVT (Model I & III only)		

Name of SFC packager: \_\_\_\_\_ Organization: \_\_\_\_\_

Signature of SFC packager: \_\_\_\_\_ Date: \_\_\_\_\_

Source(s) Verified by: \_\_\_\_\_ Organization: \_\_\_\_\_

Signature of Verifier: \_\_\_\_\_ Date: \_\_\_\_\_